
Compositional Analysis of Avocado Pulp: A Product of the Dhankuta Multiple Campus, Tribhuvan University, Dhankuta, Nepal

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Abstract

*One of the most popular tropical fruits is the avocado, or *Persea americana*, because of its high nutritional value and adaptability. The Hass kind of avocado is the most widely used cultivar worldwide. Recently, it has gained the attention of consumers, researchers, and farmers being enriched with a high nutritive profile, bioactive compounds, and phytochemicals. In the present study, the chemical composition of the edible part of Avocado fruit (pulp) cultivated in Dhankuta Municipality, Nepal was analyzed using Atomic Absorption Spectroscopy (AAS). The proximate analysis of the fruit was conducted by determining different constituents like moisture, carbohydrate, fat, fiber protein, lipid, and ash content. The tested sample of Avocado fruit contained moisture (76.4%), crude fiber (9.19%), fat (7%), protein (1.7%), and carbohydrate (4.75%) along with an energy value of 88.87 Kcal per 100g of fruit. The high water and fiber content and low fat and carbohydrate profile signify the implication of Avocado fruit as a healthier fruit in the human diet to achieve more health benefits. Further research on the nutritive value and health benefits of avocado fruit must be encouraged to improve the health status of consumers.*

Keywords: Avocado fruit, calorific value, chemical composition, health benefits

Introduction

Avocado is an economical and climacteric fruit, commonly known as butter fruit or alligator pear with essential nutrients and high energy value. It is believed to have originated in Mexico and Guatemala almost 1000 years ago (Chen et al., 2008; Tovar et al., 2007). The word 'avocado' is derived from the Spanish word 'aguacate' and the Nahuatl word 'ahuacatl,' meaning testicle, which is due to the shape of the fruit, which is believed to be an aphrodisiac (Hernandez Fernandez, 2023). The commercial cultivation of avocados was initiated in the 1950s. It was introduced to Europe and other countries including England by the Spanish, and since then, it has gained popularity worldwide as a healthy fruit. It is a popular fruit belonging to the Lauraceae family, and it has a water jar or berry-like appearance. Avocado fruit is produced by the Avocado tree (*Persea americana*) which is a tall evergreen tree (40-80) feet height and produces flowers in the spring (Ayala Silva & Ledesma, 2014).

Avocado is a tropical fruit which is mostly cultivated in tropical and Mediterranean climates around the world. Mexico, Indonesia, South Africa, Israel, Chile, etc are the leading countries for commercial production of avocado (Morton, 1987). Globally, the annual production of avocados accounted for 8.1 million tons in 2020. Being native to avocado, Mexico has a significant impact on the avocado market with 30% occupancy of global avocado production (Denvir, 2023). In the context of our country avocados are gaining popularity as their beneficial aspect is attracting farmers and consumers. In Nepal, avocado is popularly grown in Dhankuta and Shankhuwasabha districts. Among hundreds of varieties of avocado fruit, Hass, Bacon, Pinkerton, Mexicola, Holiday, Jim Bacon, Fuerte, Stewart, Zutano, Wertz, Ettinger, Lamb Hass, Sir Prize, Gwen, and Reed are cultivated in Dhankuta Municipality, Nepal (Wagle, 2023).

The avocado fruit is botanically named as a large berry with a large seed inside. Avocado fruit consists of an exocarp or skin, an edible mesocarp, and a single large seed with two cotyledons. The outer exocarp or skin is smooth or thick and leather-like in appearance with green, brown, purple, or black. The middle fleshy mesocarp is rich in fat and nutrients. The seed and skin of avocado fruit contribute to 33% of fruit weight (Dreher & Davenport, 2013). The avocado fruit is rich in carbohydrates, lipids, protein, dietary fiber, vitamins K, E, B6, and minerals like potassium and sodium (Fulgoni et al., 2010; Ford et al., 2020). Having a significant concentration of bioactive compounds and phytochemicals, many researchers have emphasized its role in reducing cancer risk, Alzheimer's disease, diabetes, depression, blood pressure, obesity, and cardiovascular diseases (Arukwe et al., 2012). The consumption of avocado is highly beneficial to our cardiovascular health. According to preliminary research, avocados may help with healthy aging and weight management (Marra et al., 2024).

Despite of being economically significant fruit with high calorific value, the research relevant to nutritional and compositional analysis of avocado fruit is limited in context of Nepal. There are few studies on physical characters of avocado at eastern, Nepal (Poudel *et al.* 2018) and physio-chemical properties of seed propagated genotypes of Dailekh district (Liutel, 2022). However, detailed study on the chemical properties of the avocado pulp of Dhankuta district has not been reported in the previous literature. In order to address this research gap, the present study was conducted to provide insight into the compositional analysis of avocados in Dhankuta Multiple Campus, Tribhuvan University, Dhankuta, Nepal. The present work also aims to aware consumers about its nutritive value and health benefits.

Materials and Methods

One of the popular Avocados was collected from the Dhankuta district. The exact place of collected Avocado was the ground of Dhankuta Multiple Campus, Tribhuvan University, Dhankuta, Nepal. The tree was near the Science block. ST 243 Soxtec™ manual extraction system with six positions and batch handling

tools was used for rapid and safe fat analysis. Then the sample was tested by the Atomic Absorption Spectroscopy (AAS) instrument of Agilent Atomic Absorption Spectrometer of AAS-Agilent 280 FS, USA which was in the Department of Food Technology and Quality Control, National Food and Feed Reference Laboratory (Babarmahal, Kathmandu). The pulp was extracted from the avocado fruit. The homogenous paste was then created. 40 gm of pulp was placed inside the crucible. The investigated sample, which identified the different nutrients found in avocado fruit samples, was created from the mother sample.

Results and Discussion

The nutrient profile of the tested avocado fruit per 100 grams comprising of water content, ash content, calorific value, and macronutrients (protein, carbohydrate, fat, and fiber) has been shown in Table 1. The tested fruit was rich in moisture and fiber content implying the application of fruit in weight and cholesterol control as well as good metabolism of the body.

Table 1 Comparative Study of Chemical Composition of Avocado Fruit (in %) per 100g

Nutrient	Present study	(Dreher & Davenport, 2013)	(Arukwe et al., 2012)	(Nwaokobia et al., 2018)	(Rozaan et al., 2021)	(Luitel, 2022)
Water	76.4	72.3	8.12	51.69	67.88	78.37
Carbohydrate	4.75	8.64	53.74	53.74	3.86	-
Protein	1.7	1.96	1.6	1.62	2.21	13.2
lipid	7	15.4	29.94	31.64	22.46	-
Ash	0.93	1.66	4.54	1.02	1.37	4.05
Fiber	9.19	6.8	2.06	1.08	2.22	-
Energy (Kcal)	88.67	167	-	-	-	-

Carbohydrates are the important macronutrient composed of sugars or polymers of sugars. They play a significant role in energy production and storage including lipid metabolism (Belitz et al., 2008; Anderson, 1998). In the present study, carbohydrate concentration was 4.75% which is slightly lower than the 8.64% reported by USDA, in 2011(Dreher & Davenport, 2013). The obtained value was lower than 53.74% by (Arukwe et al., 2012) and (Nwaokobia et al., 2018). This low carbohydrate content in present study indicates that the fruit with a low glycemic index and that the dish's primary energy source is not from carbohydrates. The reported value of carbohydrates in the present study was higher than 3.86% (Rozaan et al., 2021).

Proteins are the natural polymer of amino acid molecules. They are essential macronutrients for the proper growth and development, synthesis and maintenance of DNA, regulation of organs and tissues as well as catalyzing biochemical reactions inside the human body (Sudhakararao et al., 2019, Bangar et al., 2022). The edible pulp in the current study contained 1.7% protein per 100g of fruit which was slightly lower than the 1.96% reported by USDA, in 2011(Dreher & Davenport, 2013). Arukwe et al in 2012 and Nwaokobia et al in 2018 reported the concentration

of protein as 1.6% and 1.62% respectively, which was lower than the present study (Arukwe et al., 2012; Nwaokobia et al., 2018). Similarly, the protein content in the present study was lower than 2.21% (Rozan et al., 2021) and 13.2% (Luitel, 2022).

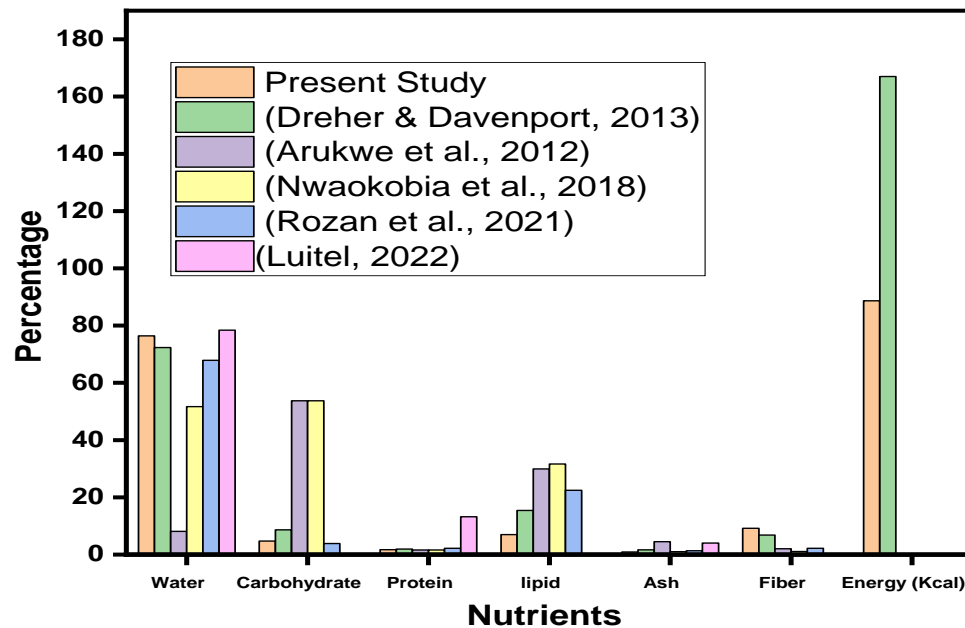
Dietary fibers are the polysaccharides and non-digestible form of carbohydrate. The value of dietary fiber in the tested avocado fruit was 9.19% which is significant. Its value was higher than 6.8 % (Dreher & Davenport, 2013). Additionally, the value of protein reported as 2.06% by (Arukwe et al., 2012), 1.08% by (Nwaokobia et al., 2018), and 2.22% by (Rozan et al., 2021) was quite lower than the present study. The high fiber content in the study signifies the application of fruit in waste elimination, control of cholesterol and glucose level as well as prevention of constipation for the maintenance of a good digestive system (Barber et al., 2020).

As an important macronutrient in the human diet, fat plays an important role in energy production and storage, absorption of fat-soluble vitamins A, D, E, and K as well as supplying insulation to the body (Wendy et al., 1998). In avocado fruit, the fat content is comprised of 71% of monosaturated fatty acid which is essential in controlling hypertension, cholesterol, and diabetes. The fat content in the present study was 7% which was lower than the 15.4%, 29.94%, 31.64%, and 22.46% reported by (Dreher & Davenport, 2013), (Arukwe et al., 2012), and (Nwaokobia et al., 2018) and (Rozan et al., 2021), respectively, per 100g of avocado fruit. However, the studied avocado pulp has a modest fat content. Depending on whether the fat is saturated or unsaturated, this could increase its nutritional content and calorie density.

The ash content is the measure of the mineral concentration in the fruit which is essential for the different health benefits and growth and development of the body (Ejiofor et al., 2018). Similarly, foods with a high ash content might be an effective way to get essential minerals including calcium, magnesium, and potassium. In the studied fruit, 0.93% per 100g was noted referring to low mineral content in the given fruit sample which is lower than 1.66% as reported by (Dreher & Davenport, 2013), 4.54% by (Arukwe et al., 2012), 1.02% by (Nwaokobia et al., 2018), 1.37% by (Rozan et al., 2021) and 4.05% by (Luitel, 2022).

The moisture content in the present study was reported to be 76.4% which is higher than 72.3%, the value of (Dreher & Davenport, 2013). Luitel in the year 2022 reported the moisture content as 78.37% which is higher than the present study (Luitel, 2022). The study by Arukwe et al., (2012), Nwaokobia et al. (2018), and Rozan et al. (2021) analyzed the value to be 8.12%, 51.69%, and 67.88% respectively, in avocado fruit which is quite lower than the present study. The high moisture content in the tested sample indicates that the fruit plays a significant role in the regulation of body temperature and the protoplasmic content of the cells (Ejiofor et al., 2018). The studied fruit pulp was with comparatively low total energy content of 88.67 Kcal per 100 grams. This suggests that the fruit had a low-calorie content despite having a moderate fat content, most likely because of its high fiber and water content.

The comparative study of the chemical composition of Avocado fruit in the present study with that of the previous literature has been represented in Figure 1. **Figure 1** Comparative Study of the Chemical Composition of Avocado Fruit



Some of the other nutrients are probably diluted by the higher water content in this sample (76.4% vs. 72.3%, 78.37%, and 67.88%), which could account for some of the lower readings. This could imply that the study's diet includes less sugar or starch-based energy-dense foods. Considering the tiny amounts in both instances, it seems unlikely that the food offers a significant source of protein. The fat content in the study of (Arukwe et al., 2012) and (Nwaokobia et al., 2018) is over four times that of the current study. In addition to this fact, (Dreher & Davenport, 2013) as well as (Rozaan et al., 2021) reported higher values of fat content i.e. two times and three times higher than the present study. This could indicate that different processing or food preparation methods were employed, or it could signify that the food investigated in this study is a reduced-fat version of the same product. There may be less minerals in the sample, according to the current study's reduced ash concentration. Compared to 1.08%, 2.06%, 2.22% and 6.8% in the report (Nwaokobia et al., 2018; Arukwe et al., 2012; Rozaan et al., 2021; Dreher and Davenport, 2013), the fiber content revealed in this study is significantly higher (9.19%). The diet in this study is, therefore, healthier for digestive health. The reduced fat and carbohydrate content in the current study accounts for the low calorific value, which is nearly half that of the data reported in the study of (Dreher & Davenport, 2013), (88.67 Kcal vs. 167 Kcal). The variation of the chemical

constituents of the Avocado fruit in the different studies with the present study is the result of the origin, climatic condition, plant nutrition, and variety of the avocado fruit used in the investigation. The quality of avocado fruit is influenced by the environmental and growing conditions of avocado fruit (Afzal et al., 2022; Ejiofor et al., 2018). Similarly, several factors, including the cultivar, stage of maturity, and even the part of the fruit being studied affect chemical composition and bioactive components of avocado fruit (Landahl et al., 2009). There is a high correlation between firmness and maturity of avocado fruit which is determined by different parameters such as dry matter, oil content, and eating quality (Salameh et al., 2022).

Conclusions

The popularity of avocados is increasing around the world due to their good taste, significant health benefits, and high nutritive profile. In the present study, the nutritional analysis of avocado fruit in Dhankuta was studied by determining water content, ash content, calorific value, and macronutrients (protein, carbohydrate, fat, and fiber). The studied fruit was rich in dietary fiber which makes it healthier for digestive health. However, the fruit contained moderate fat along with low protein and carbohydrate content. The low-calorie content of the fruit was due to its high fiber and water content. Therefore, the fruit under study imposed the potential applications as a supplement to the human diet as well as healthy ingredient in the food industry. Further studies on the proximate analysis of the different cultivars of avocado cultivated in Nepal must be encouraged to aware the consumers about the nutritive value of the fruit as well as its application in synthesis of different food products.

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Author contributions

Chandradip Kumar Yadav provided the concept, methodology, and software. Chandradip Kumar Yadav and Brahamdeo Yadav worked out almost all of the manuscript details, and data curation and performed the numerical calculations in the experiment. Jasana Maharjan and Ajaya Bhattarai supervised the findings of this work and wrote the original draft. Ajaya Bhattarai approved the final version of the manuscript.

Conflict of Interest

The authors affirm that they have no known financial or interpersonal conflicts that might have appeared to have an impact on the research presented in this paper.

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